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Research Paper

Do You Recognize the Misinformation? An Eye Tracking Study of Users Reading Behaviors

Panel 2
Technological Challenges and Innovations in Combating Disinformation

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Abstract

In a world characterized by massive digital interactions, true and false information are widely and easily distributed to society. Because of the advantage of digitally created information, it easily impacts the consumption pattern of users. This paper investigates users' reading patterns in social media-based misinformation. We experimented with eye tracker technology to better understand users' reading patterns. This research found that textual elements of misinformation attract users to scrutinize compared to the visual elements of information. The textual elements provide meaning to the readers of information, guiding them in deciding what to do after reading it. In X (Twitter) social media-based information, users started to read the names of social media accounts, scrutinize the textual elements of information, scan the visual elements, and move to look at the like or share. It also emphasized that users absorb textual elements quickly, impacting their reluctance to absorb visual elements until finished. Our finding provides a reading consumption of users in social media environments.

Keywords: *hoax, eye-tracking, reading-pattern*

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Background

In a society that is characterized by massive digital adoption, information can be distributed widely quickly (Wijaya et al., 2018). Likewise, false information can be circulated widely then massively absorbed by users. As false information commonly impacts negatively to society (Bartels, 2002), then combating the circulation of false information is a challenge for researchers and other stakeholders. False information can be distributed quickly through digital platforms due to the characteristics of the technology. The negative impact of false information ranges from harming the reputation of a person or institution to causing conflict or polarization within society (McCright & Dunlap, 2011). In addition, false information can influence the public decision-making process, damaging public trust in the governmental institution and causing public uncertainty which can mobilize community actions such as panic buying or other communal actions (Enders et al., 2020; Fernandez & Alani, 2018).

Literature shows various efforts to combat the distribution of false information. In this paper, false information, hoax or misinformation is used interchangeably. We investigated that efforts in combating misinformation can be categorized into three groups (Fernandez & Alani, 2018; Simko et al., 2019):

- **Development of detection algorithm and circulation pattern analysis methods.** This research aims to develop automatic tools for identifying hoax or misinformation using machine learning and text analysis approaches which can identify fake content. The result of these efforts can be adopted in the social media platform to help the platform prevent the circulation of fake news. Meanwhile, circulation pattern analysis results in the spread of false information on social media using algorithms to help the social media platform identify the pattern of hoax circulation and sources of misinformation. This kind of research contributes to the development of early detection algorithms for identifying the source of misinformation and characterizing the content of misinformation, which are able to prevent misinformation from being created and circulated (Saez-Trumper, 2014).
- **Human-computer interaction:** Research in this area focuses on the interaction of users with misinformation including psychological factors that influence an individual's behavior in spreading and absorbing false information, and the misinformation reading pattern of users in digital platforms. This research group contributes to providing an enhanced understanding of the way humans interact with misinformation, specifically providing an in-depth understanding of users' psychological factors related to misinformation development and absorption and the reading patterns of users related to various types of misinformation content (Simko et al., 2021).
- **Digital literacy and public policy development: This research area focuses on developing appropriate digital literacy to strengthen** individual capabilities to identify and combat misinformation (Guess et al., 2020). Digital literacy refers to the capacity of an individual to recognize and critically evaluate the content of misinformation. Then, public policiy research focuses on developing regulations in accordance with the development of social technologies which provide a space of social interactions where misinformation is widely distributed. These efforts mostly need an engagement between the governments and social media platform providers to enforce the policies, conduct monitoring, and execute punishment of

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those involved in the development and distribution of misinformation (Guess et al., 2020).

These above studies are interconnected each other's which means that each group of research are contributing to each other's. However, based on our literature review, research on the development of automatic detection tools is one step ahead of the others (Simko et al., 2019). Social media platforms have developed and implemented various detection tools to help them identify and remove misinformation. Then, this type of research is emerging in public literacy and law enforcement, and various new approaches have resulted. According to Simko et al., (Simko et al., 2021), research in the area of how human interact with false information is lacking, in particular investigating the pattern of human interaction with false information or reading eye pattern of false information. Even this type of research can contribute both to the others area, providing in depth understanding of type of misinformation and the pattern of reading which can contribute to develop more effective detection tools and providing the psychological characteristic of users who vulnerable to misinformation which can help to develop more effective educational approaches.

This paper aims to address the research gap above by investigating the misinformation reading patterns amongst social media platform users. We employed a user experiences experiment equipped with eye tracker technologies to provide a heat map and gaze plot of user reading patterns. We also interview this experiment's participants to reveal users' important experiences when interacting with the misinformation. This research addresses the following research questions:

RQ1. How do people read false information and true information on social media platforms?
RQ2. To what extent does the type of misinformation, including textual and visual information, impact users' reading patterns?

Literature Review

User Experiences Using Eye Tracker Technologies

As an emerging research area in human computer interactions studies, user experiences research provides an in-depth understanding of the way people interact with computer technology and its related digital objects contained therein. Traditionally, revealing the way people interact with computer technologies can be executed using interviews and surveys which are able to understand what people think, need, values and abilities when interacting with computer technology. However, researchers' bias is commonly found in the traditional data collection approaches as presented above. On the other side, researching human computer interactions needs objective data to help researchers reach better understanding of the way human interact with digital objects, such as reading patterns (Asan & Yang, 2015). It looks that traditional approaches, including interviews and surveys, are not enough to address these challenges.

Eye-tracker technology is a tool which is able to provide objective data on a person's eye movements (Reingold, 2014). Specifically, this tool can provide an objective data on where, when, and how long a person's visual attention to t an object or area on a digital screen or natural environment. This technology adopts cameras and

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highly sensitive sensors to track the points of a human looking at something by detecting eye movements and gaze focus. Data generated from eye-tracking can provide deep insight into a user's visual preferences, behavioral patterns, and responses to certain visual stimuli.

In research, eye-tracking is employed in various fields, from cognitive psychology to user interface (UI/UX) design. Research employed eye tracker technology can be implemented through quantitative, qualitative or both. Analyzing eye-tracker data with a statistical approach helps researchers prove various hypotheses related to human interaction with technology. The qualitative approach helps researchers reveal important information about how humans interact with the visual world, providing deep insights for product development, visual communications, and understanding human behavior in various contexts.

Users Reading Patterns of Digital Object

How users read digital objects on the screen attracts various scholars to investigate. The reading pattern explains the pattern of human eye movements when reading digital object such as textual and visual information (Jarodzka & Brand-Gruwel, 2017). According to Nielsen (Nielsen, 2006), users interact with digital objects in several ways depending on the design of the digital object and the type of information within the digital objects. In general, the concept of reading pattern explains how users put their visual attention to digital objects. This type of information and its combination affect the way users pay attention to digital objects. From the designer's point of view, reading patterns provide a strategy to design an effective and efficient digital object. The concept provides an in-depth understanding of the way a designer needs to put the text, and visual information. The most interesting findings from users' reading patterns result from various comfortable website designs that help platforms attract users to read and absorb information effectively (Jarodzka & Brand-Gruwel, 2017; Nielsen, 2006). On the other hand, this concept also helps false news creators design effective and impactful false news. By understanding how to use keywords, the size of text, the most impactful font, and how to use visual information, misinformation can easily attract users to read and absorb it.

The following paragraphs discuss several reading patterns as follows:

F-pattern refers to the reading pattern of users when interacting with textual information (Nielsen, 2006). Commonly in the culture of those who read in a left-to-right pattern (such as English), the F pattern describes the pattern of sight lines that form the letter "F". First, the reader scans the text horizontally or moves the eye horizontally from left to right at the top of the text, forming the first horizontal line of the F pattern. Then, the eye will move down slightly and make a shorter horizontal movement around the middle of the page, forming the second horizontal line of the F pattern. Finally, the eye will move vertically along the left side of the text, forming a vertical line on the left side of the F pattern.

Layer-cake (Safa & Dakakni, 2023): the reader tends to explore different verticals. They can start by reading the headline or other prominent element at the top of the page, similar to the first layer of a cake. Then, they may venture to sections they deem important or attention-grabbing, similar to selecting the next layer of a cake. Next, they can move to other, deeper layers, through scrolling or navigating to more specific parts of the text.

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Spotted (Safa & Dakakni, 2023): the reader's eyes jump from one point to another, which is considered interesting. This can include focal points such as keywords, titles, graphics, or prominent visual elements. Readers do not always follow a regular reading pattern such as an F-pattern or layer-cake pattern but rather jump from one point of interest to another.

Method

This research aims to investigate the reading behavior of users when interacting with false information. To reach the objective, we employed eye tracker technologies to reach a better understanding of users' reading pattern. Eye Tracker which is equipped with analysis software can provide more objective data including gaze plot and heat maps of users reading pattern. Although heat map and gaze plot are able to provide meaningful information of users' reading information, we still combine the data with interviews which are perceived able to reveal various information of what users' thoughts and feel when they interact with the false information. Participants were given full disclosure of the purpose of the study beforehand and signed informed consent forms. All participant data was collected and stored anonymously.

Research location
Data was collected at the Web and Mobile-based Application Laboratory which is located at Collaborative STEM Laboratory Building. The room has sufficient lighting which is sufficient for eye-tracking experiments.

Participants recruitment
Participants were selected from Generation Z who were born between 1997 and 2012. We chose 12 participants who satisfied these criteria: 1. No visual impairment; 2. Actively using X (previously Twitter) social media platform, can retweet, like and share tweets.

Eye tracker tools
We used Tobbi Glass Pro 2 which is equipped with analysis software. This tool can generate heat maps and gaze plots. It is also equipped with a high-definition camera and microphone for recording participants' voice and visual attention.

Experiment design
We developed an application with a user interface design similar to X. Two types of tweets were uploaded to the application that can be read easily by participants. Then, participants read all of the information provided by the applications.

Findings and Discussions

Findings

Figure 1 below describes the gaze plot and heatmaps of each participant when they interacted with false news circulated in the artificial social media platform. Participant 1 focuses on the text, which is an essential part of the message. He scrutinizes the content which looks like a questionable message. Then, during the reading process, Participant 1 also focused on the text or had a lot of fixations on the textual element of the message compared to the visual element of the message.

Participant 2 also showed similar characteristics of reading behavior. She focuses on the text to reach a better understanding of the message. It can be found that textual elements attract more fixation than visual elements. This finding is emphasized by Participant 3 which says during the interview:

> "I only focus on the text only, because I think through the text, we already know the tweet is content and can conclude whether the tweet is genuine information or a hoax".

He spends most of the time absorbing the information by scrutinizing the message's textual elements. Participant 4 also showed the same reading behavior. He focuses on reading the textual information and spends most of his fixation on the textual element of the message. Textual elements also serve roles as sources of essential details for participants 5. She perceives that images or visual elements sometimes only serve as a supplement that frequently does not contain any important message or only serves as a decorative image. Textual elements also help Participant 6 recognize false information quickly. His critical thinking skills help him to decide the quality of information. He moves quickly from one message to another when he feels confident in deciding on the type of information. Participant 7 emphasized the locution within a textual element of a message help him to identify the quality of the message uploaded into the platform as she:

> " I think text can show the truth of information, besides more conveys more information than other elements, text also shows language style and writing that can be an indicator of the truth of information."

Focusing on the textual rather than the visual element of information is also found in participants 8, 9, 10, 11 and 12 reading behavior.

Therefore, it can be concluded that textual elements of information attract more visual attention from users while reading on social media platforms. The reading behavior has no significant differences between false and true information. Users tend to focus on the textual elements of messages, both false and true information.

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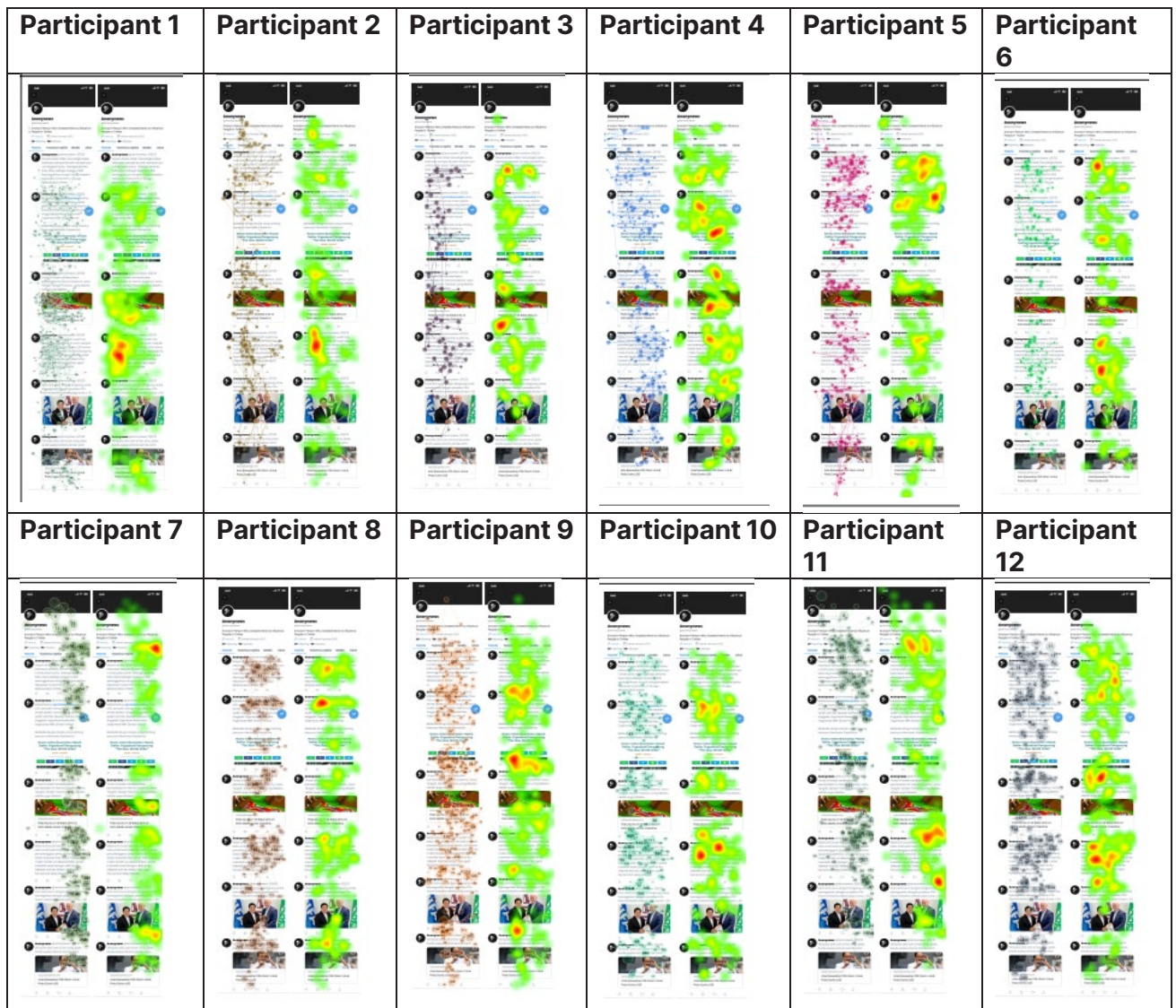| Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6
Participant 7	Participant 8	Participant 9	Participant 10	Participant 11	Participant 12

Figure 1: Participants' gaze plot and heatmaps

Users reading behavior of false information and true information have no pattern differences. They paid more attention to the textual elements compared to the visual elements. This pattern can be seen at figure 1 which provides a heat map and gaze plot of users reading behavior. The red dot shows that users pay more attention to the message element. It can be seen that more fixation means an indicator of depth of cognitive processing. It refers to the process of cognitive load or word during reading. It does not mean that other words do not attract users' attention, but they only scan the word or feel that the word is unimportant.

We also compared users' visual attention while reading a false and true message on social media platforms. All of the participants show that reading false information consumes less time compared to true information. We compared the visual attention of the participants from the gaze plot. All of the participants showed that they decided to conduct actions by liking or sharing the false message faster than conducting actions after reading true information. Most of the content of false information or hoaxes emotionally affects the participants. This type of content influences the participants' decision to conduct actions after reading the information.

Conclusion and Future Research Directions

It can be concluded that there are no significant reading pattern differences when users read false and true information. Textual elements serve as the most attractive elements in terms of attracting visual attention or fixation of users. Visual elements of the message are perceived as decorative elements from the users perspective. The visual elements sometimes help users compare the relationship between the textual and visual elements. This helps them to decide whether the information is fake or true. Reading false information is sometimes faster than reading true information due to the emotional content of false information.

This research is limited in terms of the number of participants involved. However, this research can provide meaningful user reading patterns when they interact with information on a digital platform. Further research is needed to explore users' reading patterns when interacting with fake news on various social media platforms to provide a more comprehensive model of users' reading patterns of fake news.

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